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DEFAULTABLE BONDS

ECONOFICTION BONDS, CAPITAL, FINANCE

Defaultable bonds are bonds that have a positive possibility of default. Most corporate bonds and some government bonds are defaultable. When a bond defaults, its coupon and principal payments will be altered. Most of the time, only a portion of the principal, and sometimes, also a portion of the coupon, will be paid. A defaultable (T, x) – bond with maturity T > 0 and credit rating $x \in I \subseteq [0, 1]$, is a financial contract which pays to its holder 1 unit of currency at time T provided that the writer of the bond hasn't bankrupted till time T. The set I stands for all possible credit ratings. The bankruptcy is modeled with the use of a so called loss process $\{L(t), t \geq 0\}$ which starts from zero, increases and takes values in the interval [0, 1]. The bond is worthless if the loss process exceeds its credit rating. Thus the payoff profile of the (T, x) – bond is of the form

$1_{\{LT \leq x\}}$

The price P(t, T, x) of the (T, x) – bond is a stochastic process defined by

$P(t, T, x) = 1_{\{LT \leq x\}} e^{-\int_t^T f(t, u, x) du}, t \in [0, T]$ –– (1)

where $f(\cdot, \cdot, x)$ stands for an x-forward rate. The value x = 1 corresponds to the risk-free bond and f(t, T, 1) determines the short rate process via f(t, t, 1), $t \geq 0$.

The (T, x) – bond market is thus fully determined by the family of x-forward rates and the loss process L. This is an extension of the classical non-defaultable bond market which can be identified with the case when I is a singleton, that is, when I = {1}.

The model of (T, x) – bonds does not correspond to defaultable bonds which are directly traded on a real market. For instance, in this setting the bankruptcy of the (T, x_2) – bond automatically implies the bankruptcy of the (T, x_1) – bond if $x_1 < x_2$. In reality, a bond with a higher credit rating may, however, default earlier than that with a lower one. The (T, x) – bonds are basic instruments related to the pool of defaultable assets called Collateralized Debt Obligations (CDOs), which are actually widely traded on the market. In the CDO market model, the loss process L(t) describes the part of the pool which has defaulted up to time t > 0 and $F(L_T)$, where F as some function, specifies the CDO payoff at time T > 0. In particular, (T, x) – bonds may be identified with the digital-type CDO payoffs with the function F of the form

$F(z) = F_x(z) := 1_{[0,x]}(z), x \in I, z \in [0,1]$

Then the price of that payoff $p_t(F_x(L_T))$ at time $t \leq T$ equals P(t, T, x). Moreover, each regular CDO claim can be replicated, and thus also priced, with a portfolio consisting of a certain combination of (T, x) – bonds. Thus it follows that the model of (T, x) – bonds determines the structure of the CDO payoffs. The induced family of prices

$P(t, T, x), T \geq 0, x \in I$

will be a CDO term structure. On real markets the price of a claim which pays more is always higher. This implies

$P(t, T, x_1) = p_t(Fx_1(L_T)) \leq p_t(F_{x2}(L_T)) = P(t, T, x_2), t \in [0, T], x_1 < x_2, x_1, x_2 \in I$ –– (2)

which means that the prices of (T, x) – bonds are increasing in x. Similarly, if the claim is paid earlier, then it has a higher value and hence

$P(t, T_1, x) = p_t(F_x(L_{T1})) \geq p_t(F_x(L_T2)) = P(t, T_2, x), t \in [0, T_1], T_1 < T_2, x \in I$ –– (3)

which means that the (T, x) – bond prices are decreasing in T. The CDO term structure is monotone if both (2) and (3) are satisfied. Surprisingly, monotonicity of the (T, x) – bond prices is not always preserved in mathematical models even if they satisfy

severe no-arbitrage conditions.

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